INDIVIDUAL BOOKBINDING DEVICE, SYSTEM, AND ASSOCIATED METHODS

BACKGROUND OF THE INVENTION

Cross-Reference to Related Application

This application claims priority to provisional application 60/446,013, filed on February 6, 2003, entitled "Foil-Based Resistive Strip for Individual Bookbinding System."

Field of the Invention

The present invention relates to systems and methods for binding pages together, and, more particularly, to such systems and methods for binding individual books.

Description of Related Art

A variety of different techniques are known for binding books. At one end of the spectrum is the so-called perfect binding technique used for paperback books. Individual page sheets are bound directly to the inside of the spine of the cardboard cover using a hot-melt adhesive that is solid at room temperature. Perfect binding is suitable for paperback books produced in large quantities. The high-volume machines used for perfect binding are very large and costly and must be set up for each run of books, a time-consuming process that often results in making trial copies that must be discarded. High-volume perfect binding machines are not practical for running single copies of books such as those downloaded from the Internet.

Thermal tape is another means for binding books and is often employed as a finishing operation for high-volume xerographic duplicators. The pages are individual sheets, usually 8½ x 11 inches, and the covers are cardboard sheets of the same size as the pages. Paper tape coated on one side with hot-melt adhesive forms the spine of the book, and the adhesive is activated as it passes over heated surfaces inside the machine. There is no way to print the title and author's name on the spine unless pasted on in a separate label. While thermal tape is a convenient method for binding small lots of booklets such as college course packs, such booklets do not offer the aesthetic appeal of high-quality bound volumes.

There are various other means for binding small quantities of books using staples, plastic combs, wire spirals, and plastic posts, none of which provides the look and feel of a fine bound volume.

A preferred method for binding books is the traditional cloth binding technique used for hardcover books. The pages are printed on large sheets called signatures, which are then folded, sewed and glued together, and then trimmed. The cover consists of front and back cardboard pieces encased in decorative cloth binding material, which also forms the hinges and outer spine. Cloth binding has advantages of quality appearance, durability, and ease of page turning, since the pages are glued to a flexible inner cloth spine that is fastened to the outer spine only at its edges. Like perfect binding, cloth binding is a high-volume process involving the use of large and costly machines, and is therefore not suitable for binding single copies. There are a few craftsmen who specialize in custom binding or repairing single cloth bound books, but such work is highly skilled and expensive.

At the high end of the spectrum are leather-bound books. Produced by a process similar to cloth binding, leather-bound books offer the ultimate in luxurious appearance.

It is known in the art to heat a hot-melt adhesive onto page edges to bind a book with an external heater. It is also known to heat a hot-melt adhesive coated on an electrically resistive layer applied to the inner surface of a report binder with the use of a power supply. It is also known to use a microwave-activatable adhesive to bind books, with the adhesive placed between a sheaf of papers and the binder. Additionally, it is known to employ individual book-binding apparatus following the printing of a book from a storage medium such as a database.

Although there is widespread interest in methods for binding cut sheets from desktop computer printers into high-quality books, no commercially viable, easy-to-use device has been disclosed.

SUMMARY OF THE INVENTION

The present invention provides a system and method for binding an individual book having superior aesthetic qualities, that can create a book with a plurality of cover types, including both hard covers and soft covers, and is easily adaptable to books of various sizes. Books made by the present system and method do not require trimming of the book or the binding strip upon completion of the binding process.

The present invention is directed to a system and method for binding a stack of pages along a first edge thereof to form a book. The system comprises an elongated resistive strip having an adhesive in contact with at least a portion of a first side, the adhesive having a melting temperature. The strip has two opposed ends and an electrical

resistivity extending between the ends. The strip is dimensioned to substantially cover the first edge of the stack, with the first side against the first edge of the stack. Preferably the strip has a series of alternating finely scribed, spaced-apart cuts extending therethrough. In a preferred embodiment the strip comprises a foil.

The system additionally comprises means for introducing an electrical current to pass along the strip between the ends. The current should be sufficient to create enough heat in the strip to achieve a temperature at least as great as the melting temperature. The melted adhesive then serves to bind the stack of pages together along the stack's first edge.

The features that characterize the invention, both as to organization and method of operation, together with further objects and advantages thereof, will be better understood from the following description used in conjunction with the accompanying drawings. It is to be expressly understood that the drawings are for the purpose of illustration and description and are not intended as a definition of the limits of the invention. These and other objects attained, and advantages offered, by the present invention will become more fully apparent as the description that now follows is read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A-1D illustrate the system and method of the present invention for binding an individual book.

FIGS. 2A and 2B are top and bottom perspective views of a first embodiment of the foil strip.

FIGS. 3A and 3B are top and bottom perspective views of a second embodiment of the foil strip.

FIGS. 4A and 4B are top and bottom perspective views of a third embodiment of the foil strip.

FIGS. 5A and 5B are top and bottom perspective views of a fourth embodiment of the foil strip.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A description of the preferred embodiments of the present invention will now be presented with reference to FIGS. 1A-5B.

In the present invention, the term "book" may comprise any collection of individual sheets that are desired to be bound together, and should not be taken as a limitation. Preferably all the pages should be of substantially the same size.

The invention is contemplated for use in such applications as binding a stack of pages that have been printed from another source, such a desktop computer printer, as a download from a remote location (e.g., a site on the Internet), or a storage medium such as a disk. However, this application is not intended as a limitation, and one of skill in the art will understand that the invention may be used in any binding situation.

The present invention is generally directed to the binding of books wherein electric current is used to melt adhesive positioned adjacent the page stack edge desired to be

bound in a hot-melt binder. The hot-melt adhesive is supplied in solid form, precoated on an electrically resistive strip. In use, the width of the adhesive strip can first be trimmed to the approximate thickness of the page stack of the book, such as by using ordinary office shears or a paper cutter. Similarly, the length of the strip can be trimmed to the approximate length of the page stack. Alternatively, various precut widths and lengths of strips may be supplied to a consumer.

In the embodiment of the system **10** and method of the invention shown in FIGS. 1A-1D, the resistive strip **22** is shown as being supplied precut to match the standard lengths of various books. The resistive strip **22** is placed on the spine area **801** of the cover sheet (FIG. 1A) and the page stack **90** is positioned so as to rest on the resistive strip **22** (FIG. 1B). The front **802** and back **803** of the cover **80** are folded upward along the sides of the page stack **90**, and the assemblage **95** is placed into an adjustable-width squared-U-shaped holder **91** (FIG. 1C) to maintain the position of the parts during the binding process.

Next electrical clip leads **71'** are attached to the contacts of the resistive strip **22** (FIG. 1D). A source of electrical current **92** in contact with the leads **71'** is activated, so that the flow of current for a predetermined time heats the resistive strip **22**, causing the adhesive **40** to melt. At the conclusion of the heating cycle, the clip leads **71'** are pulled out, and the page stack **90** is pressed downward toward the spine **801** to fill any spaces previously occupied by the clip leads **71'**. The assembled book is then left in the holder **91** for several minutes while the adhesive completely solidifies.

Four exemplary embodiments of the adhesive-coated flexible elongated strip of the present invention are illustrated in FIGS. 2A-5B. In all the cases contemplated in the preferred embodiments, the strip has an electrical resistivity and is coated or impregnated on at least a portion of a first side with a solidified hot-melt adhesive. Sufficient electrical current is passed through the strip to generate sufficient heat in the strip to melt the adhesive.

The resistive strip may comprise any of a number of materials known in the art, preferably a flexible material in order to impart flexibility to the binding. The material may be selected from a group consisting of metal foil or mesh; conductive inks, foils, paints, or layers printed, coated, or vacuum deposited on a paper, cloth, plastic, or another substrate; or from woven or nonwoven carbon-fiber material. These materials are not intended to be limiting on the invention.

A best mode of this invention, as believed at the date of filing this application, comprises the use of a sheet of metal foil for the resistive strip, although it will be understood by one of skill in the art that other materials such as those described above might also serve. Experiments have shown that materials such as aluminum foil and brass foil are suitable, provided such strips are fabricated with alternating finely scribed cuts as shown in FIG. 2B to raise their electrical resistance.

As an exemplary embodiment, a strip of aluminum foil 0.625 in. wide, 6 in. long, and 0.0005 in. thick has been found to have a resistance of about 0.05 ohms before the alternating scribed cuts are made. This is too low a resistance to provide a practical impedance match to a power supply and would act instead as a short circuit. One alternative to raise the resistance of the strip would be to use a thinner foil, but this would

make the foil very fragile. A more practical solution is the addition of alternating finely scribed cuts approximately 0.005 in. wide extending through the foil and spaced approximately 0.125 in. apart, which have been found to raise the resistance by a factor of ten times, to about 0.5 ohms in the example cited. Applying low voltages in the 3-5 volt range generates the power levels necessary to melt the adhesive for what is believed to be a typical book in less than one minute, typically 25 watts. In a preferred embodiment, the cuts extend inwardly from and generally perpendicular to the sides of the strip, with cuts extending from a first side alternating with cuts extending from a second side of the strip, the inner sections of the cuts overlapping along a central portion of the strip.

A first embodiment of the strip **12** of the present invention (FIGS. 2A,2B) comprises a central portion **121** that is coated on a first side **122** with a hot-melt adhesive **40**. In use, as discussed above with reference to FIGS. 1A-1D, the first side **122** is placed against the first edge **900** of the page stack **90**; the second side **123** is placed against the inside of the spine **801** of the cover **80**.

The two opposed end portions **124,125** surrounding the central portion **121** are substantially uncoated. The length **126** of the strip **12** is dimensioned to be approximately the length **901** of the page stack **90** desired to be bound; the width **127** of the strip **12** is dimensioned to be approximately the width **902** of the page stack **90**. Alternating cuts **127** are scribed through the foil partway across the width of the strip **12**, as shown in FIG. 2B. These cuts **127** greatly decrease the effective cross-sectional area of the conductor and greatly increase its effective length, thereby substantially raising its electrical resistance. As an example, experiments have shown that if the cuts **127** are scribed alternatively about

0.125 in. apart, so that the effective width of the conductor is about 0.125 in., the resistance of the strip is raised by about 10 times compared to the resistance of the same strip before scribing. The resistance can be raised by an even larger factor by scribing the cuts **127** closer together.

An unanticipated advantage of the scribed cuts **127** was found through experimentation. During the heating cycle, a limited amount of melted adhesive **40** flows through the cuts **127** to simultaneously bind the cover **80** to the page stack **90**, thus eliminating the need for precoating a separate layer of adhesive on the bottom surface **123** of the foil **12**. A second embodiment of the strip **22** of the present invention (FIGS. 3A,3B) adds upturned side edges **221** of the foil to support a thicker adhesive layer **40**, should this be desirable for securely binding certain page stacks **90** such as those where the pages have irregular edges.

A third embodiment of the strip **32** of the present invention (FIGS. 4A,4B) permits a strip of standard length to be cut by the user to fit a smaller book. In the depicted embodiment a central sector **321** is coated on a first side **322** with a hot-melt adhesive **40**, leaving two short gaps **323** and **324** in the coating. Here two end sectors **329**, terminating in spaced relation from the strip's ends **326**, are also coated with adhesive **40**. The gaps **323,324** facilitate the strip's **32** being able to be cut into shorter lengths for books having shorter spine lengths. The uncoated gaps **323,324** serve as contacts for the shorter lengths if the strip **32** is cut to length in this manner. Since the gaps **323,324** in the adhesive coating are short relative to the overall length **325** of an uncut strip **32**, there is no significant loss of binding strength for an uncut strip. One of skill in the art will recognize

that more or fewer sectors and gaps may be contemplated, for example, two end sectors with one gap therebetween.

As an exemplary embodiment, if the uncut strip is 11 in. long, two gaps **323,324** in the adhesive coating each 1 in. long centered at 2 in. and 7 in., respectively, from one end **326** will permit the user to cut the strip **32** with ordinary office shears to bind books having spine lengths of 2, 4, 5, 7, or 9 in., as well as 11 in. for the uncut strip. The advantage is that this greatly reduces the need for large inventories of strips to bind books of various sizes.

Short pieces of double-sided pressure-sensitive tape **327** are applied to the bottom surface of the strip under gaps **323** and **324** for mechanical reinforcement of the uncoated foil areas during handling, as shown in FIG. 4B. These pieces of pressure-sensitive tape **327** also serve to tack the strip **32** to the inside cover spine **801** during assembly of the book prior to the binding cycle. Additional pieces of double-sided pressure-sensitive tape **328** are also added at the ends to provide further support during assembly.

A fourth embodiment of the strip **42** of the present invention (FIGS. 5A,5B) permits a strip of standard width **421** to be cut by the user to fit a narrower book. The scribed cuts **422** extend only partway across the width of the strip **42** (FIG. 5B). The user can trim the width of the strip **42** with ordinary office shears up to the dashed lines **423** marked on the bottom of the strip **42** without severing the electrical continuity of the strip **42**.

As exemplary embodiments, strips available in standard untrimmed widths of 0.5, 0.75, 1, 1.5, and 2 in. could be trimmed to fit a continuous range of book thicknesses from

0.25 to 2 in. Again, the advantage is a greatly reduced inventory of strips needed to accommodate books of various thicknesses.

An unexpected advantage was uncovered during testing of this embodiment. For an untrimmed strip, most of the heat is generated during the binding cycle in the central part of the strip, between the dashed lines shown in FIG. 5B. However, laboratory experiments have shown that the melted adhesive in the central part rapidly transfers heat to the adhesive along the edges, which quickly melts, thus making this a practical design.

It is recognized that all these embodiments can be simultaneously incorporated into a single strip design if appropriate for such reasons as to minimize inventories.

Although much of the exposition of the present invention has been presented in terms of binding paperback books, it is obvious that the same system and method apply equally well to the binding of cloth- and leather-bound books.

In the foregoing description, certain terms have been used for brevity, clarity, and understanding, but no unnecessary limitations are to be implied therefrom beyond the requirements of the prior art, because such words are used for description purposes herein and are intended to be broadly construed. Moreover, the embodiments of the apparatus illustrated and described herein are by way of example, and the scope of the invention is not limited to the exact details of construction.